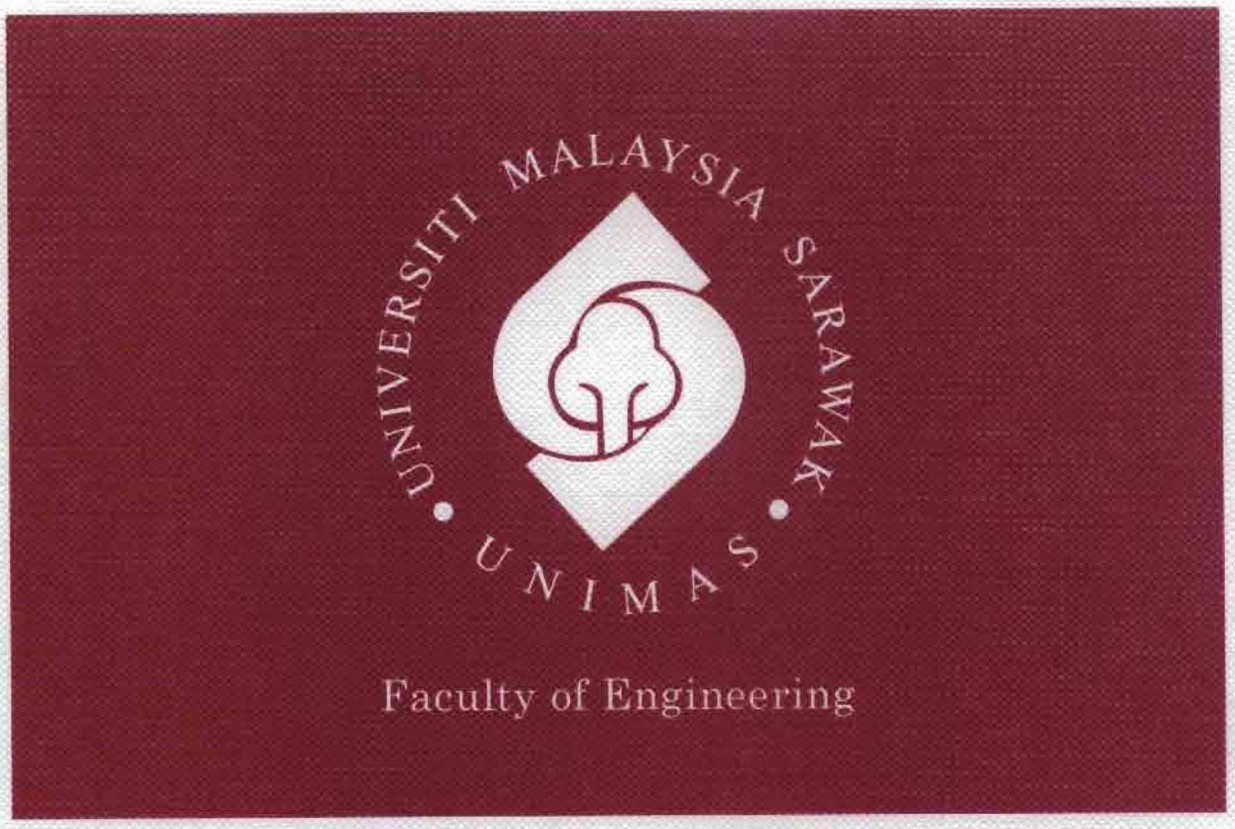

BASIC STRENGTH PROPERTIES OF *ONCOSPERMA TIGILLARIUM* AT SMALL CLEAR

Mohd. Faiz Jafni Bin Ahmad Mustafa

Bachelor of Engineering with Honours
(Civil Engineering)
2014

UNIVERSITI MALAYSIA SARAWAK

Grade: WK01

Please tick (√)

Final Year Project Report	√
Masters	
PhD	

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BASIC STRENGTH PROPERTIES OF *ONCOSPERMA TIGILLARIUM* AT SMALL CLEAR

MOHD. FAIZ JAFNI BIN AHMAD MUSTAFA

Thesis is submitted to
Faculty of Engineering, Universiti Malaysia Sarawak
In Partial Fulfillment of the Requirements
For The Degree of Bachelor of Engineering with Honours
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ABSTRAK

Dalam dunia moden masa kini, hutan konkrit merebak dengan cepat sekali di seluruh dunia menolak hutan semula jadi keluar dari jalan. Konkrit menjadi bahan binaan yang semakin menuntut; Walau bagaimanapun harga konkrit tidak murah. Oleh itu, kayu, bahan binaan yang boleh diperbaharui dan mesra alam diminta keluar sebagai alternatif dalam industri pembinaan. Seperti mana-mana bahan pembinaan lain, kayu mempunyai rintangan sendiri dari segi degradasi biologi, rintangan kimia, kestabilan dimensi, rintangan haba, luluhawa dan kerosakan. Walau bagaimanapun, jika dirawat dengan betul, balak boleh menjadi saingan sengit untuk konkrit. Selain itu, kayu mempunyai nilai estetika yang sangat tinggi berbanding dengan bahan-bahan pembinaan lain. Kayu keras adalah jenis kayu sering dipilih sebagai bahan struktur kerana ia mempunyai kekuatan yang lebih tinggi, tetapi memerlukan masa yang sangat lama untuk matang; kira-kira 100 tahun. Oleh itu, spesis kayu berkembang pesat dengan nama *Oncosperma Tigillarium* atau lebih dikenali dengan nama biasa, kelapa Nibong dipilih untuk dieksperimentasikan untuk menentukan sifat-sifat asas fizikal dan sifat mekanikal dalam mencari alternatif kepada kayu keras. Oleh itu, satu siri ujian telah dijalankan ke atas specimen dalam keaadaan 'air-dry' *Oncosperma Tigillarium* untuk mengkaji sifat-sifat kekuatan seperti kekuatan lenturan, kekuatan mampatan selari dengan ira, kekerasan dan rintangan hentaman antara sampel dari 6 batang pokok berbeza. Ujian dijalankan mengikut Piawaian British BS 373: 1957. Spesimen diperolehi dalam kawasan kampus Universiti Malaysia Sarawak (UNIMAS). Ujian makmal telah dijalankan di Perbadanan Perhutanan Sarawak (SFC). Berdasarkan analisis data, *Oncosperma Tigillarium* menunjukkan ciri-ciri kekuatan yang setanding dengan kayu keras sederhana atau kayu keras yang lain walaupun ia dianggap sebagai 'non-worthy timber'.

ABSTRACT

In the modern world today, concrete jungles are spreading like wildfire all over the world pushing natural forests out of the way. Concrete becomes an ever demanded construction material; however the price of concrete is not cheap. Therefore, timber, a renewable and eco-friendly construction material is sought out as an alternative in the construction industry. Like any other materials, timber has its own setbacks in terms of biological degradation, chemical resistance, dimensional stability, thermal resistance, weathering and decay. However, if treated properly, timber can become a fierce adversary to concrete. Moreover, timber has a very high aesthetic value compared to other construction materials. Hardwood is the type of timber often chosen as structural material as it has higher strength, but requires a very long time to mature; about 100 years. Thus, a species of fast-growing timber of name *Oncosperma Tigillarium* or better known for its common name, Nibong palm is chosen to be experimented on to determine its basic physical properties and mechanical properties in the search for an alternative to hardwood timber. Therefore, a series of tests were conducted on air dry specimens of *Oncosperma Tigillarium* to study the strength properties such as bending properties, compressive strength parallel to grain, hardness and impact resistance between samples from different culms. Tests are carried out in accordance to British Standard 373: 1957 Method for testing small clear specimens of timber. Specimens were obtained within the vicinity of the Universiti Malaysia Sarawak (UNIMAS) campus. The laboratory tests were conducted at the Sarawak Forestry Corporation (SFC). Based on the data analysis, *Oncosperma Tigillarium* shows strength properties which are comparable to other medium hardwood or even hardwood even though is it classified to be a non-worthy timber.

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LIST OF ABBREVIATIONS

ASTM	-	American Society for Testing and Materials
BS	-	British Standard
FRIM	-	Forest Research Institute of Malaysia
SFC	-	Sarawak Forestry Corporation
FSP	-	Fiber Saturation Point
MOE	-	Modulus of elasticity
MOR	-	Modulus of rupture
MC	-	Moisture content

CHAPTER 1

INTRODUCTION

1.1 General

Timber is one of the oldest materials used in construction since the birth of construction technology. It is one of the most readily available materials in recent times. Timber was the main material used in construction before concrete and steel construction methods were discovered. Timber is divided into two, softwood and hardwood. Hardwood is wood from *angiosperm* trees, strictly speaking non-monocot *angiosperm* trees while softwood is wood from *gymnosperm* trees.

Figure 1.1: A Structure Constructed Mostly of Timber (Architizer, 2013)

Wood is easily handled; it has a long lifespan and nearly unlimited applications whether in construction or other usages. No other building material is produced and used with as little energy and damage to the environment as wood. Compared to other building materials, wood is light in weight and highly resilient. Countless bridges, towers and wooden structures all over the world bear witness to this statement. Wooden houses, roof trusses, walls, floors and stairs have been in use for generations. Wood dwellings over 700 years old, yet still inhabited today, are proofs of wood's lifelong durability as a building material. People choose to build with wood on the grounds of economy, aesthetics and biology. Wood radiates warmth and is harmless to the environment. Additionally, modern construction methods do not require any chemical preservative treatments. Timber construction materials undergo strict control checks concerning quality and performance. The quality of many timber products is ensured by specific standards. Efficient prefabricating, smooth processing and constant availability make construction with wood quick and economic. Building with wood is always the right choice (GermanTimber, 2007).

Timber is without a doubt one of the most environmentally friendly building materials available in the environmentally challenged world we live in today. It is remarkably versatile, able to work well with other materials such as concrete and metal as composite structures. It is also naturally renewable but requires human ethics to preserve its renewability. Timber also has high aesthetic value and not to mention light and strong to build structures with. It also has an inviting, warm and welcoming sense which makes us feel cozy and comfortable. Whether it is a landmark building, government office, housing, school or hospital, architects look to timber to express contemporary art and beauty in the structure they design. Timber is a high performance material, light in weight, yet with excellent load bearing and thermal properties (Brash, 2008).

1.2 Problem Statement

Deforestation and global warming are not a new epidemic in the modern world today. Vast development in developed and developing countries are stripping the Earth of its forests. Timber is abundant in most countries especially tropical countries like in the Southeast Asia or South America. Although there are still abundant trees in the

world, it doesn't mean we can chop every tree we see just for our own personal gain. Mother Nature has taken care of us for generations; it's time for us to give back to Mother Nature.

Figure 1.2: Deforestation (Compost, 2013)

Most hardwood stands mature in 70 to 120 years. With proper management, renewing the forest takes less time. The time required to mature a hardwood tree depends on the species. An oak tree requires 80-120 years to mature, whereas a poplar tree can mature and be ready to harvest in 40 years or less (Unknown). It takes tens of years to grow a single hardwood tree, but it takes merely hours to chop down entire forests. Irresponsible logging is one of the major factors which affect the sustainability of timber as construction materials or other usages. Loggers who do not cut down the tree properly will cause the tree to not regenerate. Harvesting timber also requires skills.

Thus, an alternative to slow growing hardwood is required to compensate for the long time required to grow hardwood timber. Fast-growing timbers such as medium hardwood, light hardwood and softwood are being tested and experimented to find the most suitable alternative which could make timber the new concrete or steel. *Oncosperma tigillarium* is a very amazing-looking, tall, large, slender palm massed with armed trunks, armed trunks and beautiful, elegantly-arched, drooping, leathery fronds, which is sparsely distributed along the inland fringes of mangrove forest and other low, wet, swampy vegetation. Its trunk is slender, up to 15 centimeters in diameter, ringed

with old leaf scars, with up to 50, densely armed with scattered, slender black spines that are about 5 to 10 centimeters long; crown shaft are conspicuous and armed with slender, black spines. Fronds are feather-shaped, ascending to spreading, pendulous, elegantly-arched, armed, and dark to bright green. Inflorescences are ramified (multi-branched) and yellow, up to 80 centimeters long, infrafoliar (emerging from below the fronds) and armed. Its flowers are arranged in groups of 3 (2 male flowers to 1 female flower). Its fruits are globose, 1 centimeters in diameter, mildly-depressed, purple to black and single-seeded (Ridley, 2012). *Oncosperma tigillarium*'s common name is Nibong palm in English or simply "Nibong" in Malay. *Oncosperma tigillarium* may prove to be a breakthrough in the search for new fast-growing timbers for construction purposes. It is available in abundance in the forests of Sarawak and can also be exploited for plantation of softwood timber and harvested for construction purposes. Strength properties at small clear will be tested for this tree species.

Figure 1.3: *Oncosperma Tigillarium* (Ridley, 1864)

1.3 Aims and Objectives

In this research report, the timber with the scientific name *Oncosperma tigillarium* or better known for its common name in Malaysia, 'Nibong' is one of the

fast-growing timber available in the forests of Malaysia and also Indonesia where it is said to originate (Ridley, 2012).

The main aim in this project is to investigate and acquire the information on the relationship of distribution patterns of strength and physical properties with small clear sample sizes of the *Oncosperma tigillarium* timber.

Objective:

1. To determine the strength and physical properties at air-dry conditions of *Oncosperma tigillarium,*
2. To understand the relationship between the variation of strength from pith to sapwood of *Oncosperma tigillarium, and*
3. To identify the distribution pattern of strength and physical properties with *Oncosperma tigillarium.*

1.4 Scope of Work

A series of study and laboratory tests are required to be done in order to achieve the aim and objective. In order to accomplish this, certain scopes of study of work shall be done so that the whole laboratory procedures can be run at a more systematic way. The test will be conducted by using 20 x 20mm (A) x 300mm (L) and 20 x 20mm (A) x 60mm (L) small clear size sample. Laboratory tests will be carried out to determine the strength and physical properties of *Oncosperma tigillarium* at air-dry conditions. The types of laboratory tests to be carried out are as in the table below:

Table 1.1 Laboratory tests for strength and physical properties of timber

No.	Laboratory Test
1	Static bending test
2	Compression test
3	Moisture content test
4	Basic density test
5	Hardness test

The sample of *Oncosperma tigillarium* to be used in this research study was collected in the wetland forest areas within the UNIMAS vicinity. The sample collection and sample preparation procedure are discussed more elaborately in Chapter 3. This research implements the standards from BS 373: 1957: Methods for Testing Small Clear Specimens of Timber.

1.5 Chapter Outline

This report consists of five chapters. Chapter one will focus on the importance of timber and the role and contribution of timber in the construction industry. Chapter one shall also cover the problem statement, aim and objective, scope of works and chapter outline.

Chapter two consists of the literature review regarding this project. This chapter explains about the test that is listed under scope of works for further improvement.

Chapter three covers the methodology; where it elaborates on the methods used in this research mainly sample collection and preparation.

Chapter four is results and discussion; this chapter shall convey the results gathered from the series of laboratory tests and the discussions regarding the findings.

Chapter five is conclusion and recommendation, this chapter explains about the conclusion of this research and recommendation on this research for further improvement.

CHAPTER 2

LITERATURE REVIEW

2.1 General

Due to its heterogeneity and species diversity, timber is a complex building material. Timber does not have consistent, predictable, reproducible and uniform properties as the properties vary with species, age, site and environmental conditions (Ahamada Zziwa, Yasin Naku Ziraba, & Mwakali., 2009). The demand for quality timber for construction will increase in Malaysia and other developing countries due to a boom in the building construction industry. With extreme exploitation and scarcity of traditional hardwood timber species such as chengal (*Neobalanocarpus heimii*) and meranti (*Shorea spp.*), there is a diversity of previously unpopular species on the market. Zziwa et.al., (2009) revealed that there are 48 timber species on market and despite the big number, consumers prefer only 20%. The durability, integrity and safety of structures from such species cannot be assured. Reliable structural use of timber has always been hampered by lack of appropriate design codes and well-established standards.

Timber is one of the oldest construction materials used. In Malaysia, timber used to be the main materials used to build houses, especially traditional Malay houses. Examples of landmark timber structures in Malaysia are Istana Lama which was built in 1902, Istana Kenangan Perak which was built in 1960 and lastly Kampung Laut Mosque which is over 300 years old. Until today, timber has been the preferable material used for the construction of residential areas in European countries and North America (Ahmad, 2011).

Why should we build with timber? For one, timber is a renewable resource. According to Ahmad (2011), the growth rate of commercial forests in North America is